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JAN 1993
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Pondcrete
Project

January 20, 1993

Mr. Tom Beckman
Contract Technical Representative
Solar Ponds Remediation Program
EG&G Rocky Flats Project
Building 080
P.O. Box 464
Golden, CO 80402-0464

Subject: Rocky Flats Plant Solar Evaporation Ponds Stabilization Project
[WBS 231 TREATABILITY STUDY - HALLIBURTON NUS ROCKY FLATS]
Freeze/Thaw Temperature Study
RF-HED-93-0049

Dear Mr. Beckman:

Enclosed is a Revision 1 proposal for implementing a freeze/thaw study on stabilized surrogate waste. Revision 1 includes changes to revision 0 as requested by Mr. Leon Collins on January 8, 1993. As stated in the cover letter to our revision 0 proposal, the purpose of the study is to:

1) Evaluate applicability of treatability study results for pondcrete, saltcrete, pondsludge and clarifier materials with freeze/thaw test results.
2) Evaluate the freeze/thaw characteristics of halfcrates in an unheated, sheltered environment.
3) Predict number of annual freezing cycles in the halfcrates over the last 10 year period at Rocky Flats.

The study can be used to resolve concerns related to temperature impacts on the stability of newly stabilized and remixed material. Modification #11 requires HNUS to submit a proposal for long term durability tests. These field tests are required to allow HNUS to be responsive to the long term treatability study proposal required in modification #11 to be conducted in the laboratory.

The December 22, 1992 letter from Mr. E.M. Lee (92-RF-14925, EML-207-92) states "You are also tasked to delete references to surrogate materials handling and surrogate process testing from those procedures identified in Modification 11 of contract PC84017JB". We understand this to refer to SO and pre-operational system testing, and not to this or any other study intended to more fully understand the character of the final waste form.

Estimates have been finalized for this study, and all costs available are included within the proposal due to EG&G by January 15, 1993.

If you have any questions, please contact Jack Templeton at the Broomfield Office.

Sincerely,

HALLIBURTON NUS ENVIRONMENTAL
CORPORATION

John A. Schmidt

John A. Schmidt
Deputy Project Manager

JAS:tw
Enclosure

(Freeze/Thaw Temperature Study Determination of Cycles in Surrogate Waste Order of Magnitude Estimate)

cc: S. Heiman
B. Orwig

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RF-HED-93-0049

FREEZE/THAW TEMPERATURE STUDY
DETERMINATION OF CYCLES IN SURROGATE WASTE
ORDER OF MAGNITUDE ESTIMATE

Revision 1 January 19, 1993

I. OBJECTIVE

The objective of the Freeze/Thaw Temperature Study is to determine the number of freeze/thaw cycles occurring, and the durability of stabilized waste during the winter months at unheated, covered locations at Rocky flats. This is necessary as the stabilized waste produced during Pondsludge stabilization and Pondcrete/Saltcrete reprocessing might have to survive several winters on site prior to shipment to Nevada. The durability will be determined using measured temperature and strain data obtained on surrogate halfcrates and an unsteady-state dynamic heat transfer model.

The study includes using water, bentonite and a pozzolan mix as a surrogate for the remixed Pondcrete, and a brine solution and a pozzolan mix as a surrogate for the future Clarifier/C Pondcrete and remixed Saltcrete.

Because of the large mass contained in each halfcrate, and the relatively low thermal conductivity of concrete, a halfcrate can be expected to undergo fewer freeze/thaw cycles than ambient conditions. The primary purpose of this test is to determine the number of freeze/thaw cycles that a halfcrate or collection of halfcrates would experience over a given length of time. The data collected may be used to better interpret the durability tests performed in previous treatability studies, and to better focus subsequent treatability testing.

II BACKGROUND

The Rocky Flats Plant site is located on the eastern foothills of the Rocky mountains and is thus subjected to extremely low wintertime temperatures, as well as wide temperature swings from the afternoon to night. As cement stabilized waste forms are susceptible to degradation due to freezing and thawing or humidity changes, we must ensure that newly stabilized pondsludge or reprocessed Pondcrete/Saltcrete withstands the freeze/thaw cycling occurring during extended storage.

As the newly stabilized waste will have an entirely different mix recipe than the Pondcrete and Saltcrete billets presently stored on site, it is quite possible that the newly stabilized wastes will contain very little free water. Without free water, freeze/thaw will not occur. However, internal expansion and contraction will occur due to temperature variations within the blocks, and must be quantified.

The HNUS Treatability testing on Pondsludge and Pondwater has shown that the proposed stabilized waste mix formulation will produce a product that will withstand a minimum of 12 freeze/thaw and wet/dry cycles. Twelve cycles were selected in compliance with ASTM Procedure D560-89, Standard Test Methods for Freezing and Thawing Compacted Soil-Cement Mixtures. The only remaining information required is an estimate of the number of annual freeze/thaw cycles at Rocky Flats, and the internal expansion/contraction forces the newly stabilized waste will undergo as a result of temperature variation at Rocky Flats. This study is intended to address and answer concerns regarding degradation of the newly stabilized waste during long term storage.

III METHOD

EG&G provided halfcrates, complete with cardboard and plastic liners, will be filled with stabilized surrogates similar to the proposed future Clarifier/C Pondcrete and remixed Pondcrete/Saltcrete. In the case of the future C Pondcrete and Saltcrete surrogate, a second plastic liner will be used to simulate the plastic bladder proposed for actual use. Using plastic liners instead of bladders will facilitate placement of the Resistance Temperature Detectors (RTD's) and strain gauges, and avoid any delays due to fabrication of bladders. Each halfcrate will weigh up to 4700 pounds with a configuration of 2x4x7. Currently triwalls are excluded from the study, as they are not an acceptable waste container. 1

Ten halfcrates of remixed Pondcrete surrogate (hereafter referred to as remixed Pondcrete surrogate), and three halfcrates of future Clarifier/C Pondcrete and remixed Saltcrete surrogate (hereafter referred to C Pondcrete surrogate) will be produced. Under our present processing scenario, the remixed Pondcrete will be thermodynamically similar to the future A/B Pondcrete. This similarity will make it possible to use the remixed Pondcrete surrogate results to predict Freeze/Thaw cycling for the future A/B Pondcrete. Each halfcrate will contain a number of RTD's and strain gauges depending on its use. Four concurrent tests are proposed. 1

The first test involves a single remixed Pondcrete surrogate halfcrate containing RTD's and strain gauges placed in carefully selected locations in the block. This block will be located in an unheated, sheltered location. Monitoring the temperature change and internal strains in this block will yield the heat flux and strain forces occurring through the remixed Pondcrete surrogate matrix, which will be used as empirical data to fit the parameters of the mathematical model. 1 1

The second test will be identical to the first test, but using the C Pond surrogate waste, and will be used to modify the remixed Pondcrete surrogate mathematical model for the future C Pondcrete and remixed Saltcrete, if necessary. 1

Concurrently, the third test involves monitoring the temperature change and internal strains of several remixed Pondcrete surrogate halfcrates in an 8 block stack, located in an unheated, sheltered location. This will provide the data which will allow us to calibrate the single block models to duplicate a stack of halfcrates stored in an unheated, sheltered location. 1

The fourth test involves monitoring as in the first and second tests a single remixed Pondcrete surrogate halfcrate and a single C Pondcrete Surrogate halfcrate in a heated, temperature regulated location. These are the control tests, and will indicate any data differences due to chemical reactions occurring within the matrix which may affect internal temperature or expansion/contraction forces.

At the test location, the halfcrates (except for those used for the control tests), will be placed into an unheated tent where the single blocks will stand alone and the 8 blocks will be stacked in a 2 by 2 by 2 halfcrate high configuration. If the halfcrates are stored outside prior to the beginning of the study, it may be necessary to initially move them into a heated location prior to an unheated one, in order to record the heat flux and strain data during freezing.

All of the RTD's and strain gauges will be connected to a data logger, or a laptop PC (already procured for use in the C Pond Process conveyor control system) through a data acquisition board. This will minimize manpower and cost while collecting and compiling the data.

As the internal temperature of the halfcrates decreases towards the ambient air temperature of the tent during cold weather, the internal block temperatures of the single halfcrate and the stacked halfcrates and the ambient air temperature will be monitored. As the ambient air temperature increases during warm weather, the internal temperature of the blocks will increase, and the temperature rise for thawing will be documented. Though heat flux is numerically the same for heating and cooling, this will directly validate the thaw portion of the model, while confirming the heat flux data collected during the freezing portion of the study.

Once the internal temperature of the single remixed Pondcrete surrogate halfcrate decreases approximately 5 to 10°F, the initial data will be sent to Brown and Root Houston where it will be used in the generation of an unsteady-state dynamic heat transfer model for a single remixed Pondcrete surrogate halfcrate subjected to ambient conditions during winter at Rocky Flats. By assuming an air space between the halfcrates, the model will then be expanded to include a stack of halfcrates. The data generated from monitoring the C Pondcrete surrogate halfcrate will be used to modify the model, if necessary, for a stack of C Pondcrete and remixed Saltcrete halfcrates. The data generated from monitoring the stack of halfcrates is necessary to validate the accuracy of the model for the conditions studied, and will be used to calibrate the model to accurately represent the unsteady-state heat transfer in a stack of halfcrates.

Once the models are generated and validated, the actual ambient air data collected at Rocky Flats for the last 5 to 10 winters will be entered into the model to calculate the number of effective freeze/thaw cycles and predict the internal expansion/contraction forces occurring for a given storage period (8 to 10 years). This information combined with the additional testing shown in Section IV will then make it possible to anticipate the impact of local long term storage of stabilized waste forms.

IV ADDITIONAL TESTS AND DATA TO BE COLLECTED

In addition to the above tests, the following will be determined:

- Laboratory determination of the Freezing point of actual stabilized waste;
- Laboratory determination of the Freezing point of the two surrogates;
- Laboratory determination of the free water contained in the cured stabilized surrogates;
- Temperature profiles inside an unheated tent at the Rocky Flats Plant site and the corresponding plant temperature as documented by Rocky Flats Meteorological department;
- Compressive and tensile analyses on core samples taken after the completion of the test; and
- Temperature data for the last 10 years from the Rocky Flats Meteorological department.

V COST ESTIMATE

A. Production of Surrogate Halfcrates

Mobilize standard Halliburton Services RCM (Recirculating Cement Mixer) to Colorado, possibly Brighton, and blend water, bentonite, and a pozzolan mix to produce 10 remixed Pondcrete surrogate halfcrates, and blend brine and a pozzolan mix to produce 3 C Pondcrete surrogate halfcrates. Deliver these halfcrates to Rocky flats site, or an alternate location for temperature and strain profile study.

ESTIMATED COST FOR STEP A . . . . . Listed in Mod. 11 Cost Proposal

REQUIRED EQUIPMENT:

1 RCM (cement mixer)
2 densometers
2 4000 gallon transports
1 Portable blending scale system
2 660 cu ft storage trailers
1 trailer (halfcrate delivery)
1 fork lift (halfcrate movement)
6 tractors
2 pickups

MATERIALS:

Type V Cement	- 11,400 lb.	(121 cu ft)
Flyash	- 22,800 lb.	(308 cu ft)
Lime	- 854 lb.	(27.5 cu ft)
Plasticizer	- 0.1 lb./100 lb. pozzolan	
Brine solution	- 600 gal	
Water supply	- 5,200 gal	

20 halfcrates (for test & washup, complete with cardboard and 25 plastic liners)
RTD's (each with 25 feet of cable)
Strain Gauges (each with 25 feet of cable)

PERSONNEL:

1 Test Supervisor
1 Test Foreman
1 RCM Operator
1 Batch Mixer Operator
1 660 Operator
1 Scale Tank Operator
1 Transport Operator
1 Data Acquisition Operator
2 Halfcrate Operators
1 Fork Lift Operator
1 B&R Process Engineer
1 B&R Instrument Engineer

13 TOTAL

SCHEDULE:

Notification	- 2 weeks
Mobilization	- 3 days
Setup	- 3 days
Produce Crates	- 1 day
Demobilization	- 3 days

B. Temperature and Strain Monitoring of Halfcrates

The temperature and strain profiles of the halfcrates will be monitored using a laptop PC. Data will be taken from the time the blocks are situated to the middle of April. The PC can be maintained in a lock-box, and should require attention only once daily to collect the previous days data.

EQUIPMENT REQUIRED:

Laptop PC (already procured for the project)
Data Acquisition Board
Data Logger (alternative to PC)
Lock-box
Ambient Air RTD's

ESTIMATED COST FOR STEP B . . . . Listed in Mod. 11 Cost Proposal

C. Generation of Heat Transfer Model

Development of the model can be divided into 4 parts:

1. Develop theoretical model
2. Analyze meteorological data
3. Estimate model parameters from empirical data and generate statistics
4. Operate "fitted" model with meteorological data and generate statistics

We estimate TBD weeks
to complete at a cost of . . . . Listed in Mod. 11 Cost Proposal
(includes program proofing and validation)

D. Determination of Internal Expansion/Contraction Forces

The data obtained from monitoring the forces within the halfcrates will be used in conjunction with the heat transfer model to determine and predict expansion/contraction forces occurring within the halfcrates.

We estimate TBD weeks
to complete at a cost of . . . . Listed in Mod. 11 Cost Proposal

E. Determination of Freeze/Thaw Cycles at Rocky Flats Site

The daily high/low data collected by Rocky Flats meteorological department will be input to the model, to determine the number of number of freeze/thaw cycles occurring inside unheated tents at Rocky Flats, for the last 10 years. 1

We estimate TBD weeks
to complete at a cost of . . . . Listed in Mod. 11 Cost Proposal